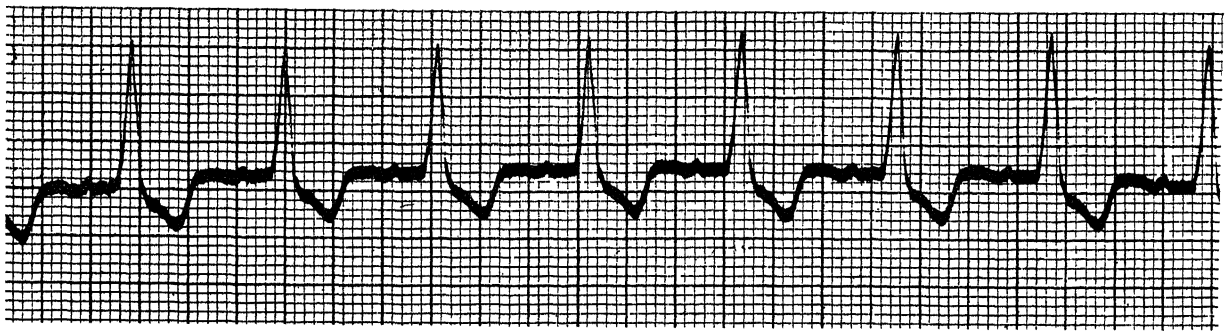

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Factors Related To Heart Disease Among Ohio Farmers

• AN EPIDEMIOLOGICAL ANALYSIS OF MORTALITY DATA

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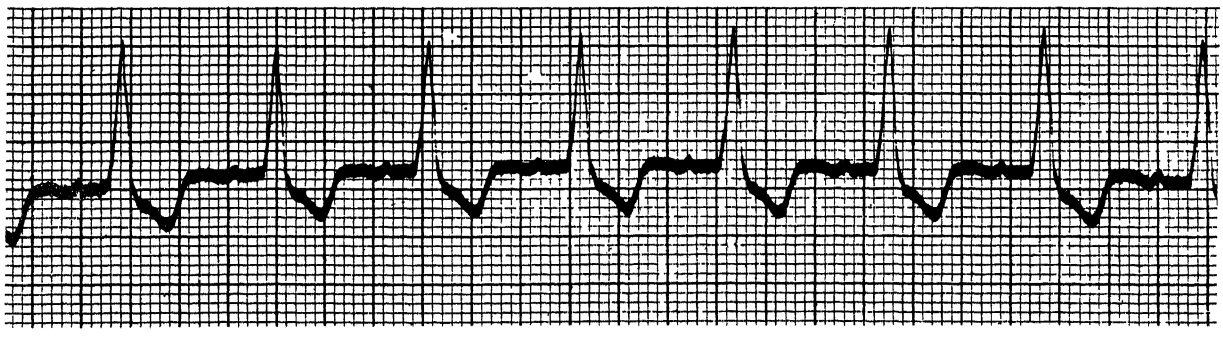

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FACTORS RELATED TO HEART DISEASE AMONG OHIO FARMERS*
An Epidemiological Analysis of Mortality Data

Saad Z. Nagi**

SUMMARY

This publication reports the findings of an epidemiological analysis of heart disease mortality data of rural Ohio. Prevalence rates of death by five types of heart disease were obtained from the Division of Vital Statistics of Ohio Department of Health. These types are: rheumatic heart diseases, arteriosclerotic including coronary heart diseases, other degenerative heart diseases, hypertensive heart diseases and other diseases of the heart. Data descriptive of several demographic, occupational, sociological and economic community characteristics were obtained from other secondary sources.

The variables used to describe these characteristics are: social control, density of population, population stability, per cent of rural non-farm population, per cent employed in agriculture of total population employed, farm operator level of living, the level of rural farm housing conveniences, median years of schooling completed by farm people of 25 years of age and over,

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*Supported in part by a grant from the Central Ohio Heart Association.

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per cent of farm operators working off the farm, per cent of farm operators classified as tenants, average value of farm, land and buildings per farm, average value of farm products sold per farm, per cent of farms classified as commercial, average size of farm, farm mechanization, average pounds of whole milk sold per farm and the proportion of acreage used in intensive farming (fruits and vegetables) to total cropland harvested.

The purpose of the analysis was to delineate variables that are associated with the prevalence rates of death by diseases of the heart and to study the nature and degree of that association.

The methods used in this analysis were based upon three main steps: First: The rates of fatalities were adjusted to age. Second: The effect of the level of health services available in Ohio counties upon reporting diseases of the heart as causes of death, was determined. That effect was found too small to introduce any significant bias in results of the analysis. Third: Ohio counties were ranked according to their age-adjusted rates of death by the different diseases of the heart, and also according to their scores on the demographic, occupational, sociological and economic dimensions. A matrix of intercorrelations was computed between all these variables including rates of death by the different heart diseases. The rank difference correlation method was used.

Tables including mortality rates specified by age, sex, race,

marital status and place of residence are presented. Crude and age-adjusted rural death rates by the different types of heart disease for all Ohio counties are also incorporated in Appendixes I and II. Several important points should be noted. Age-adjusted rates exhibited a different pattern than that of crude rates. The association between age and heart disease fatality rates is clear in the data presented. Urban rates were consistently higher than the rural ones except in the category of "other diseases of the heart." It should be noted also that "arteriosclerotic including coronary heart diseases" accounted for over two-thirds of total deaths by diseases of the heart.

The last category of findings deals with results of the correlation analysis. Several variables showed significant correlations with arteriosclerotic including coronary heart diseases and other degenerative diseases of the heart. Two variables showed significant correlations with hypertensive heart diseases. No significant correlations were found between either rheumatic or other diseases of the heart and any of the variables used in the analysis.

Some explanations and hypotheses are advanced as possible interpretations for the results obtained. These interpretations are limited to arteriosclerotic and hypertensive diseases of the heart. Findings of this part of the analysis were found consistently to support the general hypothesis that links emotional stress and

arteriosclerotic heart disease. Emotional stress was measured here through sociological and economic indicators. The assumption is that conditions of sociological and/or economic stresses are conducive to emotional and psychological stresses. Factors indicative of social complexities and disorganization as well as those indicative of low income, high operational risks and inefficient operations were found to be significantly associated with age-adjusted death rates by arteriosclerotic including coronary heart diseases.

It should be noted that correlation coefficients in themselves do not establish causal relationships. Interpretations suggested in this publication linking heart disease to emotional and psychological stresses are advanced only as hypotheses that need further investigation under more rigorously controlled experimental conditions.

INTRODUCTION

The prominence of heart disease as a cause of illness and fatalities in the United States is clear and impressive. In recent morbidity surveys, heart disease ranked second only to mental disorders as a cause of chronic illness.[1] Vital statistics reports of the United States as well as those of the individual states show that diseases of the heart have been consistently occupying first place among causes of death over the last few decades. Knowledge of the causal factors of a disease is necessary for accurate diagnosis as well as effective prevention and treatment.

There are two major and complementary methods of approach to the search for causal explanations of a disease. First, is an epidemiological approach, i.e., the study of the distribution of a disease among certain populations including the conditions under which the disease thrives or is inhibited. Essentially, this is an

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Special acknowledgment is due to the personnel of the Division of Vital Statistics of the Ohio Department of Health, especially Dr. E. Coulter, Dr. M. Guy and Mrs. E. Everett for their valuable help and cooperation. Acknowledgment is also due to Dr. T. H. Andrews and Dr. E. F. Baumer of the Department of Agricultural Economics and Rural Sociology and to Dr. C. T. Jonassen of the Department of Sociology for their helpful suggestions and making their data available.

[1] See for example Commission on Chronic Illness, Chronic Illness in a Large City: The Baltimore Study, Harvard University Press, Cambridge, Mass., 1957, pp. 73-103.

ecological approach to the study of disease.[2] The purpose of studies on this level is to delineate factors associated with the disease and provide guiding hypotheses for experimental research and preventive programs. Second, is an experimental approach, the purpose of which is to establish the causal explanations of the disease, through more rigorous control over the factors involved.

This report deals with findings of an epidemiological analysis of heart disease mortality data. This analysis was done as a part of a research project conducted by the Ohio Agricultural Experiment Station.[3] The purpose of the analysis was to identify factors that are associated with the prevalence rates of death by certain diseases of the heart, among rural-farm residents of Ohio and to determine the nature and degree of that association.[4] Several demographic, occupational, economic and sociological variables were used in this study.

SOURCES OF DATA

This analysis utilized two categories of data obtained from secondary sources. The first category is that of mortality by

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[2] J. R. Paul, "Epidemiology" in D. E. Green and V. E. Knox, Research in Medical Science, N. Y., Macmillan, 1950, p. 53.

[3] The project is concerned with the study of "The Sociological and Social-Phychological Factors Related to the Etiology of, and Adjustment to, Heart Disease Among Ohio Farmers." The project is supported by a grant from the Central Ohio Heart Association, Columbus, Ohio.

[4] The term "rural" is used here to refer to what is called "county health jurisdictions," i.e., places of less than 5,000 population. Data are also available for total counties and for the urban parts of the counties, i.e., places of 5,000 population and over.

heart diseases. The second category of data is constituted of those relating to demographic, occupational, economic and sociological characteristics used in the analysis. Descriptions of these data and their sources are presented in the following paragraphs.

Heart Disease Mortality Data

Mortality data are collected by health departments by means of death certificates. These certificates provide information about causes of death as well as other demographic characteristics of deceased individuals.[5] Causes of death are coded according to an international method used by member nations of the World Health Organization.[6] In cases where more than one disease existed, it was agreed upon to report the underlying cause of death which was defined as:

> The disease or injury which initiated the train of morbid events leading directly to death, . . . symptoms or modes of dying . . . are not considered to be causes for statistical purposes.[7]

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[5]Reports about death rates from the different causes analyzed by demographic characteristics are issued periodically by Vital Statistics Division of Health Departments.

[6]See World Health Organization, Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death, Vols. I & II, Sixth Revision Adapted 1948. W. H. O. Geneva, Switzerland.

[7]Ibid., p. 345.

Data about heart disease mortality in Ohio were provided by the Division of Vital Statistics of the Ohio Department of Health. These data were obtained in the form of crude death rates for the following diseases of the heart.[8]

1. Rheumatic heart diseases . . . . . (410-416)
2. Arteriosclerotic heart diseases including coronary diseases and angina pectoris . . . . . (420)
3. Other degenerative heart diseases . . . (421-422)
4. Hypertensive heart diseases . . . . . (440-443)
5. Other diseases of the heart . . . . . (430-434)
6. Total . . . . . (410-443)

Data used in the analysis were those of 1956. Ranks of Ohio counties on rural death rates from heart disease (410-443) in 1956 were correlated with their ranks on the average rates of 1955, 56 and 57. A correlation coefficient of .91 was obtained. In view of this high correlation and the fact that the analysis is based upon rank order correlations, rates of 1956 were considered as representative of the average rates for the period of 1955 to 1957.

Data Relating to Other Variables

A number of other variables were used in the analysis with the purpose of identifying those associated with heart disease mortality,

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[8] Ibid., pp. 132-139. Figures refer to code numbers of diseases mentioned.

and determining the direction and degree of that association. These variables represent certain demographic, occupational and socio-economic characteristics of Ohio counties. The following is a listing and a brief description of the variables used as well as the sources from which data were obtained. In order to maintain consecutive numbers for all variables included in the analysis, and since the different categories of heart disease occupy the first six numbers, the listing of other variables will start by number seven:

7. Social Control: This is a combined index based upon the reversed ranks of Ohio counties on crime and delinquency rates. Thus, counties with the lowest crime and delinquency rates become highest in scores on social control. Figures used are of 1950.

8. Density of Population: This is measured by the number of people per square mile. Figures used are of 1950.

9. Population Stability: This is a combined index based upon the ranks of Ohio counties on (a) per cent of dwelling units owner occupied in 1950, and the reversed ranks on (b) per cent of houses constructed since 1940, and (c) per cent of population living in another county in 1949.

Ranks of Ohio counties on the three above mentioned variables were obtained from: Christen T. Jonassen, The Measurement of Community Dimensions and Predictive Indices Significant for Educational Administrators, Center for Educational Administration, College of Education, The Ohio State University, 1956.

10. Per Cent of Rural Non-Farm Population: Figures used are those of 1950 based upon the 1940 census definition of "urban."[9]

11. Per Cent Employed in Agriculture of Total Population Employed: Males and females are included in these figures. Data used are those of 1950.

12. Farm Operator Level of Living:[10] This is a combined index based upon (a) percentage of farms with electricity, (b) percentage of farms with telephones, (c) percentage of farms with automobiles, and (d) average value of products sold or traded in the year proceeding the census (adjusted for changes in purchasing power of the farmer's dollar). Figures used are of 1954.

13. The Level of Rural Farm Housing Conveniences: This is a combined index based upon percentage of dwellings with (a) flush toilet, private bath and running water, (b) electric light, (c) central heating, and (d) mechanical refrigerator. Figures used are of 1950.

14. Median Years of Schooling Completed by Farm People, of 25 Years of Age and Over: Figures used are of 1950 and based upon the 1950 Census definition of "urban."

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[9] See U. S. Department of Commerce, Bureau of the Census, 1950 United States Census of Population, P-B 35 United States Printing Office, pp. IV - VI.

[10] M. J. Hagood, G. K. Bowles and R. R. Mount, Farm-Operator Level-of-Living Indexes: For Counties of the United States 1945, 1950 and 1954. Statistical Bulletin No. 204. Agricultural Marketing Service, U. S. D. A., March, 1957.

15. Per Cent of Farm Operators Working Off the Farm: These figures include all farm operators working off the farm regardless of the length of time they spend in off-farm work. Figures used are of 1954.

16. Per Cent of Farm Operators Classified as Tenants: Figures used are of 1954.

17. Average Value of Farm, Land and Buildings Per Farm: Figures used are of 1950.

18. Average Value of Farm Products Sold Per Farm: Figures used are of 1950.

19. Per Cent of Farms Classified as Commercial: Farms are generally classified as commercial when farm products sold amount to the value of $1,200 or more. Figures used are of 1950.

20. Average Size of Farm: Figures used are of 1950.

21. Farm Mechanization: This variable is measured by a combined index based upon (a) number of tractors per 1,000 acres cropland harvested, (b) number of trucks per 1,000 acres cropland harvested, (c) number of dollars spent for gas, fuel, oil per 10 acres cropland harvested, and (d) number of dollars spent for electricity per month per 100 acres cropland harvested. Figures used are of 1950.

Ranks of Ohio counties on the last twelve variables, Nos. 10 to 21 were obtained from: Wade H. Andrews and Lorenzo H. Snow,

Comparative Population, Agricultural and Industrial Data for Ohio Counties, 1940-1950, mimeograph, AD 248, Ohio Agricultural Experiment Station, Wooster, Ohio. Ranks based upon more recent figures than those of 1950 were obtained from unpublished material by W. H. Andrews.

22. Average Pounds of Whole Milk Sold Per Farm: Figures used represent an average of those of 1949 and 1954. Figures of 1949 were obtained from: Elmer F. Baumer and R. H. Pollock, Shifts in Milk and Cream Production in Ohio, Research Circular 24, Ohio Agricultural Experiment Station, February, 1954. Figures of 1954 were obtained from unpublished material by E. F. Baumer.

23. Intensive Farming: This is a ratio of the amount of land used in crops requiring intensive farm operations, to the amount of cropland harvested in the county.[11] Data used are of 1950.

Total Acreage occupied by these crops were obtained from: Wade H. Andrews and Saad Z. Nagi, Migrant Agricultural Labor in Ohio, Research Bulletin 780, Ohio Agricultural Experiment Station, September, 1956. Data on total cropland harvested were obtained from "Bureau of the Census," U. S. Department of Agriculture, 1950 United States Census of Agriculture, Ohio, Vol. 1, Part 3.

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[11] Crops designated as requiring intensive farm operations include: potatoes, sugar beets, vegetables, fruits, nuts, grapes and berries.

METHOD OF ANALYSIS

Heart disease mortality rates, like death rates of other diseases, are tabulated by the Division of Vital Statistics individually for places with populations of 5,000 and over. Rates for the balance of each county, i.e., open country and places of less than 5,000 population, are combined and reported as "General Health Jurisdictions." This analysis is concerned primarily with rates of the general health jurisdictions which will be referred to as "rural rates." The plan of analysis is organized around the following steps:

1. Adjusting Rates to Age:

Since most types of heart disease are highly associated with age, crude death rates obtained from Vital Statistics records were adjusted to age in order to obtain standarized rates. Age-adjusted rates were obtained by the direct method using the 1950 population of continental United States as a standard.[12]

2. Determining the Effect of the Level of Health Facilities:

It is a widely accepted notion that the accuracy of diagnosing and reporting diseases of the heart as causes of death, is influenced by the level of health facilities available.[13] This step in the

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[12] M. J. Hagood, Statistics for Sociologists, Henry Holt and Company, New York, 1947, pp. 822-847.

[13] E. A. Lew, "Some Implications of Mortality Statistics Relating to Coronary Artery Disease," Journal Chron. Dis. 6, 3: 192-209, September, 1957.

analysis was designed to test this hypothesis and determine the nature and degree of that influence. An index measuring the level of health services available in Ohio counties was computed.[14] Index scores of the counties were correlated with their age-adjusted death rates by the different types of heart disease.[15]

3. Measuring the Association Between Heart Diseases' Death Rates and the Other Variables:

The 88 counties of Ohio were ranked on their rural age-adjusted death rates by the different types of heart diseases, and also according to the demographic, occupational, economic and sociological variables included in the analysis. A matrix of intercorrelations for all the variables was computed, using the method of rank difference. Correlations of the different types of heart disease with their total (410-443) were not computed, since such correlations are expected to yield spurious results.

FINDINGS

Three groups of findings are presented in this report. First of these groups includes prevalence rates of death by different types of heart disease in Ohio. The second group of

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[14] S. Z. Nagi and A. W. Orcutt, "An Index of Health Services for Ohio Counties," a report in progress. This index is based upon five aspects of health services: the proportions of physicians, dentists, nurses to a certain base of population, the percentage of hospital needs met and the per capita health appropriations.

[15] The method used is that of rank difference correlation.

findings deals with the relationship between the levels of health services and the reported heart diseases' death rates. The third and final group of findings deals with the relationship of certain socio-economic, environmental and occupational factors to the prevalence rates of mortality by the important diseases of the heart.

Prevalence Rates of Mortality by Heart Disease

Before focusing the attention upon heart disease fatality rates in rural Ohio it is felt advantageous to give a brief description of these rates in the state as a whole. This description includes a discussion of specific rates by age, sex, race, marital status and place of residence.

Crude rates of mortality by diseases of the heart (410-443) for the state were found to range from a high of 571.73 per 100,000 population in Brown County, to a low of 232.08 in Greene County. The average rate for the state was 369.24 per 100,000 population. When adjusted to age, these rates exhibited a somewhat different pattern. Age-adjusted rates for the same diseases of the heart (410-443) ranged from 437.86 in Jefferson County to 222.86 in Paulding County. The average rate for the state was 342.88 per 100,000 population.

Age-Specific Mortality Rates

Mortality rates by the different types of heart diseases specified by age groups are presented in Table 1, which shows the high degree of association between age and death by diseases of the heart. Rates of fatalities by these diseases increase considerably after the age of 25 and accelerate rapidly after the age of 45.

Table 1. Heart Disease Death Rates by Age Groups

(Rates are per 100,00 population)

Age Group	Rheumatic H.D. (410-416)	Arterio-sclerotic* H.D.(420)	Hyperten-sive H.D. (440-443)	Other H.D. (421-434)	Total (410-443)
Under 1	—	.52	—	2.60	3.11
1 - 4	—	—	—	1.29	1.29
5 - 14	.29	.07	—	.36	.73
15 - 24	2.31	.64	.16	1.27	4.38
25 - 44	7.27	27.71	3.54	3.72	42.24
45 - 64	26.31	349.81	51.26	35.71	463.10
65 & over	48.01	2003.86	379.12	456.82	2887.80
All ages	12.41	261.24	45.76	49.83	369.24

*Including Coronary Heart Disease and Angina Pectoris.

Sex-Race-Specific Mortality Rates

Table 2 shows the crude and age-adjusted death rates by diseases of the heart specified by sex and race. It should be pointed out that total rates of death by diseases of the heart (410-443), were higher for males than females. Crude rates for non-whites are either close to, or considerably lower than those of whites except in the case of hypertensive heart disease. However, age-adjusted rates for non-whites are considerably higher than those of whites. This can be interpreted in view of the higher life expectancy for whites than non-whites. These figures also indicate significantly higher rates of death by hypertensive diseases of the heart (440-443) among non-whites especially females.

Table 2. Crude and Age-Adjusted Heart Diseases Death Rates in Ohio, by Sex and Race

(Rates are per 100,000 Population)

Types of Heart Diseases	Sex and Race				Average Rates
	White		Non-White		
	Male	Female	Male	Female	
Rheu. H.D. (410-416)					
Crude Rate	12.25	12.59	11.30	13.05	12.41
Age-Adjusted	11.70	11.69	13.37	15.31	11.83
Arter. H.D. (420)					
Crude Rate	342.04	196.56	211.99	147.18	261.24
Age-Adjusted	321.35	167.59	270.89	204.03	242.70
Hyper. H.D. (440-443)					
Crude Rate	37.24	46.25	93.15	111.72	45.76
Age-Adjusted	34.86	40.10	117.60	144.17	42.37
Other H.D. (421-434)					
Crude Rate	51.74	48.39	56.17	37.46	49.83
Age-Adjusted	48.45	41.70	74.81	50.23	45.98
Total (410-443)					
Crude Rate	443.27	300.79	372.61	309.41	369.24
Age-Adjusted	416.36	261.08	467.67	413.74	342.88

Mortality Rates by Marital Status:

Due to the lack of tabulations of marital status-age-specific death rates by heart diseases, age-adjusted rates by marital status could not be computed. Table 3 shows the crude rates of heart disease deaths by four marital status categories, i.e., single, married, widowed and divorced. Rates presented are for population of 14 years of age and over.[16] It should be noted that this table does not present sound age basis for a comparison between the different categories of marital status. For example, the category of single is expected to be over-loaded by younger

[16] In order to obtain population bases for these rates, percentages representing four categories of marital status for population of 14 years of age and over in the 1950 census were projected into 1956 estimates of population of the same ages. The number of heart disease fatalities below 14 years of age were all deducted from the single category.

ages while that of widowed is expected to be constituted of older age groups. The table, however, is presented for the benefit of those who are interested in further research. It offers also sex and race comparisons by marital status.

Table 3. Crude Heart Diseases Death Rates in Ohio by Marital Status, Sex and Race, 14 Years of Age and Over

(Rates are per 100,000 population)

Diseases of Heart Sex and Race	Single	Married	Widowed	Divorced	Total*
Rheu. H.D. (410-416)	8.33	15.72	39.58	25.79	16.36
White Male	7.24	17.74	37.30	23.99	16.30
White Female	9.91	13.91	40.92	24.20	16.48
Non-White Male	9.09	14.07	36.87	13.70	14.22
Non-White Female	2.49	14.10	35.53	68.51	17.38
Arter. H.D. (420)	133.92	270.74	1471.20	444.27	343.56
White Male	156.69	429.56	2217.73	763.67	453.10
White Female	113.71	124.91	1264.82	200.93	252.96
Non-White Male	121.84	229.41	1209.17	602.82	275.74
Non-White Female	49.95	107.83	734.38	216.94	196.03
Other H.D. (421-434)	30.30	37.56	384.43	86.49	65.42
White Male	32.38	51.33	492.03	127.95	68.37
White Female	30.07	23.33	361.49	45.24	63.23
Non-White Male	20.00	55.59	405.52	191.81	72.95
Non-White Female	9.99	26.08	180.63	91.35	49.01
Hyper. H.D. (440-443)	23.00	39.19	329.66	75.21	60.25
White Male	18.03	40.47	329.93	91.96	49.35
White Female	26.23	29.44	307.75	41.03	60.41
Non-White Male	47.28	108.37	516.11	260.31	123.42
Non-White Female	29.97	100.08	491.56	148.44	148.36
Total (410-443)	199.55	363.21	2224.87	631.76	485.59
White Male	214.34	539.09	3076.99	1007.57	587.45
White Female	179.93	191.51	1974.98	313.50	393.08
Non-White Male	198.22	407.45	2167.66	1068.64	486.34
Non-White Female	92.41	248.07	1442.11	525.23	410.76

*Two-hundred and thirty cases reported as unknown marital status were deducted from this table.

Mortality Rates by Place of Residence

Crude and age-adjusted rates of death by diseases of the heart by place of residence are included in Table 4. It should be noted that urban figures exhibit higher rates than those of the rural parts of the state, except in the case of "other diseases of the heart (421-434)" for which rural rates, both crude and age adjusted, were higher.

Table 4. Crude and Age-Adjusted Death Rates by Diseases of the Heart in the Rural and Urban Parts of Ohio

(Rates are per 100,000 population)

Type of Heart Disease	Rural*	Urban**	State Average
Rheumatic H.D. (410-416)			
Crude Rate	11.37	13.03	12.41
Age-Adjusted	11.38	12.11	11.83
Arter. inc. Coronary H.D. (420)			
Crude Rate	244.13	271.41	261.24
Age-Adjusted	228.81	250.78	242.70
Hyper. H.D. (440-443)			
Crude Rate	37.15	50.87	45.76
Age-Adjusted	34.09	47.02	42.37
Other H.D. (421-434)			
Crude Rate	54.17	47.25	49.83
Age-Adjusted	45.73	43.81	45.98
Total (410-443)			
Crude Rate	346.82	382.56	369.24
Age-Adjusted	320.01	353.70	342,88

*Places of less than 5,000 population.
**Places of 5,000 population and over.

Mortality Rates in Rural Ohio

Crude and age-adjusted rates of deaths by the different types of heart diseases for the rural parts of Ohio counties are included in

Appendixes I and II. As shown in Table 5 the total crude rates (410-443) ranged from 571.75 per 100,00 population in Brown County to 196.42 in Scioto County. The total age-adjusted rates ranged from 438.61 in Jefferson County to 219.21 in Van Wert County. The state average for crude and age-adjusted rural rates were 364.24 and 323.77 per 100,000 population respectively.

Table 5. The Range of Crude and Age-Adjusted Rural Rates of Mortality by the Important Types of Heart Disease in Ohio

(Rates are per 100,000 population)

Type of Heart Disease	High		Low		State
	Rate	County	Rate	County	Average
Rheum. H. D. (410-416)					
Crude Rate	35.05	Morgan	0	Several	11.37
Age-Adjusted	31.80	Morgan	0	Several	11.38
Arter. Inc. Cor. H.D.(420)					
Crude Rate	424.30	Noble	113.08	Scioto	244.13
Age-Adjusted	339.97	Clark	127.13	Scioto	228.81
Other H.D. (421-422)					
Crude Rate	148.73	Coshocton	5.42	Hancock	.....
Age-Adjusted	120.39	Coshocton	4.62	Hancock	.....
Hyper. H.D. (440-443)					
Crude Rate	91.52	Monroe	6.83	Greene	37.15
Age-Adjusted	69.40	Brown	6.22	Fayette	34.09
Other H.D. (423-434)					
Crude Rate	49.28	Monroe	0	Gallia	.....
Age-Adjusted	29.03	Defiance	0	Gallia	.....
Total (410-443)					
Crude Rate	571.75	Brown	196.42	Scioto	364.24
Age-Adjusted	438.61	Jefferson	219.21	Van Wert	323.77

It should be pointed out that the category of "arteriosclerotic including coronary heart disease (420)" accounts alone for over two-thirds of the total deaths by diseases of the heart. It should be noted also that the effect of adjustment to age upon death rates was more

pronounced in regard to heart diseases that are more associated with age such as the arteriosclerotic and hypertensive types.

The Level of Health Services and Mortality Rates

As mentioned before, the second methodological step in this analysis was aimed at testing the relationship between the level of health services available and the rates of mortality by diseases of the heart. The purpose of this step was to determine whether or not the level of health services affects the accuracy of diagnosing and reporting heart disease deaths enough to introduce serious bias in mortality rates.

Results obtained show that no significant correlations exist between the level of health services and rheumatic heart diseases ($r = .03$ $P > .05$), hypertensive heart diseases ($r = .17$ $P > .05$) or the category of other diseases of the heart ($r = .07$ $P > .05$).

A positive correlation was obtained between the level of health services and the death rates of arteriosclerotic (including coronary) heart diseases (420) ($r = .22$ $P < .05$). Other degenerative heart diseases (421 and 422) were found to be negatively correlated with the level of health services ($r = -.26$ $P < .05$). These correlations may suggest a lack of distinction in diagnosing and reporting these two categories of heart diseases in places with poorer health services, which results in reporting some cases of (420) under (421 and 422). If that is the case, a negative correlation would be expected to exist between the two categories of disease, (421, 422) and (420). However, the correlation coefficient obtained between them, as shown in Table 6,

refutes this hypothesis, ($r = .02$ $P > .05$). This indicates that each of these two categories of heart diseases varies independently with the level of health services. It should be noted also that; although correlation coefficients found between the level of health services on one hand and each of the two categories of heart disease (420) and (421 and 422) on the other, were significant, their coefficients of determination are too small to become sources of bias.[17]

Factors Associated with Heart Disease Mortality

In the third and final methodological step of this analysis, coefficients of correlations were computed between the rural age-adjusted rates of mortality by the different types of heart diseases and 17 other variables. These variables represent sociological, economic and occupational characteristics of Ohio counties with specific emphasis upon rural life. The matrix of intercorrelations, Table 6, shows the following important findings:

Rheumatic heart disease (410-416) did not exhibit significant correlations with any of the other variables used in the analysis.

Arteriosclerotic, including coronary heart disease, showed significant correlations with 12 variables. Fatality rates by this type of disease showed a significant positive correlation with density of population, part-time farming, farm mechanization, milk production per farm and the proportion of land used in intensive farming. These rates

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[17] The accepted level of significance is at .05.
A coefficient of determination = $r.^2$

were found to correlate negatively with social control, per cent of people employed in agriculture, proportion of tenancy, value of farm land and buildings, average value of farm products sold per farm, per cent of farms classified as commercial and the average size of farms.

Rates of degenerative diseases of the heart (421 and 422) varied independently from those of (420) in their relationships to county characteristics. Rates of (421, 422) were found to correlate positively with social control and the percentage of rural non-farm population and negatively with farm operators level of living, rural-farm housing conveniences, median years of schooling completed by farm people of 25 years of age and over, the value of farm land and buildings, the value of farm products sold per farm and the average pounds of whole milk production per farm.

Hypertensive diseases of the heart (440-443) showed significant correlations with two variables only; a positive correlation with the density of population ($r = .22$ $P < .05$), and a negative one with the average size of farms ($r = -.36$ $P < .01$). It is interesting to note the similarities between hypertensive and arteriosclerotic including coronary heart diseases in their relationships to other variables.

No significant correlations were found between other diseases of the heart (430-434) and any of the variables included in the analysis.

Finally, mortality rates by total diseases of the heart (410-443) were found to be significantly correlated with eight variables.

TABLE 6. RANK DIFFERENCE INTERCORRELATIONS (ρ) OF DISEASES OF THE HEART AND THE OTHER SOCIO-ECONOMIC VARIABLES

(N = 88)

•	1 (410-416)	2 (420)	3 (421 & 422)	4 (440-443)	5 (430-434)	6 (410-443)	7 Social Control	8 Density of Population	9 Population Stability	10 % Rural Non-Farm Population	11 % Employed in Agriculture	12 Farm Operator Level of Living	13 Farm Housing Conveniences	14 Schooling Completed by Farmers	15 % Part-Time Farmers	16 Proportion of Tenancy	17 Value of Farm Land & Buildings	18 Value of Farm Products Sold	19 % Commercial Farmers	20 Average Size of Farm	21 Mechanization per Acre	22 Whole Milk Produced	23 Intensive Farming
1																							
2	.17																						
3	-.13	.02																					
4	.12	.10	.03																				
5	-.09	.02	-.15	-.19																			
6	....	....	....	....																			
7	.00	-.24	.25	-.06	.05	-.10																	
8	.10	.25	-.19	.22	-.03	.18	-.63																
9	-.08	.00	.13	.16	.07	.19	.37	.56															
10	-.02	-.15	.22	-.08	.17	-.33	.47	-.47	-.07														
11	-.05	-.36	.19	-.11	.02	-.21	.55	-.93	.12	.45													
12	-.03	-.07	-.25	.01	-.10	-.16	-.35	.33	-.23	-.39	.17												
13	.04	.14	-.25	.19	.12	.06	-.45	.70	-.13	-.52	-.61	.66											
14	-.08	.04	-.29	.07	.06	-.08	.44	.57	-.28	-.39	-.48	.61	.80										
15	-.02	.26	-.02	-.11	.18	.26	-.26	.39	-.05	.03	-.49	-.33	.07	.08									
16	-.06	-.24	-.04	-.05	-.08	-.23	.07	-.23	-.12	-.07	.36	.62	.08	.12	-.76								
17	.01	-.20	-.25	-.03	-.05	-.25	-.15	.18	-.25	-.26	-.03	.81	.53	.45	-.58	.76							
18	.00	-.20	-.21	-.01	-.12	-.24	-.09	.11	-.18	-.26	-.08	.88	.47	.42	-.75	.80	.94						
19	-.04	-.24	-.02	-.02	-.11	-.19	.16	-.37	.12	-.09	.49	.55	.12	.18	-.78	.89	.70	.76					
20	.00	-.32	.00	-.36	.13	-.29	.27	-.59	.15	.07	.50	.19	-.35	-.19	-.50	.58	.21	.28	.47				
21	.06	.37	-.02	.13	.04	.32	-.35	.54	-.22	-.03	-.62	-.38	.16	.03	.76	-.82	-.53	-.62	-.88	-.73			
22	.06	.23	-.21	.08	-.13	.07	-.44	.62	-.24	-.28	-.57	.16	-.51	.49	.36	-.35	.03	.04	-.35	-.58	.46		
23	-.03	.25	-.06	-.02	.07	.17	-.28	-.52	.15	-.13	-.58	-.15	.28	.10	.58	-.63	-.26	-.34	-.65	-.55	.74	.40	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

.05 LEVEL OF SIGNIFICANCE = .20
.01 LEVEL OF SIGNIFICANCE = .26

They were correlated positively with part-time farming and mechanization per acre, and negatively with proportion of rural non-farm population, per cent of people employed in agriculture, proportion of tenancy, value of farm land and buildings, average value of farm products sold per farm, and the average size of farms. The correlation coefficients found between total death by diseases of the heart (410-443) and the socio-economic variables are largely the function of mortality by arteriosclerotic including coronary heart disease (420), which constitutes over two-thirds of the total rates.

The matrix of intercorrelations was completed beyond these first six variables in search for possible interpretations for the relationships between heart disease fatality rates and the other socio-economic variables.

SUGGESTED INTERPRETATIONS AND HYPOTHESES

Interpretations presented here will be limited to findings related to arteriosclerotic, including coronary, diseases of the heart (420). This is due to the importance of this category of diseases and its statistically significant mortality rates. However, interpretations advanced, can be applied also to findings related to hypertensive diseases of the heart (440-443). In their relationships to the demographic, occupational and socio-economic characteristics of counties, death rates of hypertensive heart diseases exhibited a pattern very similar to that of arteriosclerotic diseases of the heart.

Emotional and occupational stresses have been widely recognized as factors contributing to the etiology of arteriosclerotic, coronary and hypertensive diseases of the heart. The lack of research aimed at the investigation of this general hypothesis is probably due to the methodological problems involved in quantifying and measuring these types of stresses. However, there are some clinical and statistical studies that were designed around certain aspects of this problem.[18] Findings presented in this report tend generally to support the evidence obtained through most of these studies which relates emotional and occupational stresses to arteriosclerotic and coronary diseases of the heart.

The Role of Emotional Stresses

It is the contention here to interpret the relationships found to exist between death rates of arteriosclerotic heart diseases and certain sociological and economic variables in view of the emotional stresses these variables may precipitate. The assumption is that conditions of sociological and/or economic stresses are generally conducive to emotional and psychological stresses. In other words, emotional stresses are measured indirectly in this study through sociological and economic factors.

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[18] For example, see W. H. Chambers, and H. F. Reiser, "Emotional Stress in the Precipitation of Congestive Heart Failure," Psychosomatic Medicine, 15: 38-60, 1953; and H. E. Russek and B. L. Zohman, "Relative Significance of Heredity, Diet and Occupational Stress in Coronary Heart Disease of Young Adults," Am. Jour. of Med. Sc., 235, 3: 266-275, 1958.

Sociological Factors:

Sociological data pertinent to this type of study are hard to obtain from secondary sources. However, two of the variables included in the analysis can be used as indicators of sociological stresses. These variables are social control and density of population. As previously explained, social control is measured by an inversed index of crime and delinquency rates. Since crime and delinquency constitute two important sources of sociological stresses, the degree of such stresses should be expected to vary negatively with the degree of social control.

The second variable with important sociological implications is that of the density of population. Certain sources of sociological stresses such as complexities in life situations and role conflicts are characteristic of urbanization which is highly associated with the density of population.

In view of the general hypothesis relating arteriosclerotic heart diseases to emotional stresses, mortality rates by these diseases should be expected to correlate negatively with the degree of social control and positively with the density of population. Results obtained in the analysis and presented in Table 6 substantiate these hypotheses. Correlation coefficients found to exist between the counties' ranks on age-adjusted death rates by arteriosclerotic including coronary heart diseases (420) and their ranks on social control and population density were ($r = -.24$ $P < .05$) and ($r = .25$ $P < .05$) respectively. It should be noted that death rates by hypertensive diseases of the heart (440-443) followed a similiar pattern in their relationships to these two sociological variables.

Economic Factors:

Stressful economic conditions in farming may result from a variety of factors, among the more important of which are those related to low income, high operational risks and inefficient farming operations.

Low income: Low income farmers often lack in reserve and savings, and therefore, are usually vulnerable to fluctuations in farm production, market conditions and other aspects of the farming business. Stressful economic situations are expected to occur more often among these farmers than among those with higher income levels. On this basis, it can be concluded that mortality rates of arteriosclerotic heart disease should be expected to correlate negatively with factors indicative of income levels among farmers. Results obtained in this analysis and shown in Table 6, consistently support this hypothesis. Death rates by arteriosclerotic including coronary heart diseases (420) were found to be negatively correlated with the average value of farm land and buildings ($r = -.20$ $P<.05$), the average value of farm products sold per farm ($r = -.20$ $P<.05$), the per cent of farms classified as commercial ($r = -.24$ $P<.05$) and the average size of farms ($r = -.32$ $P<.01$).

These results do not necessarily contradict the findings obtained through other studies, which indicate a curvilinear relationship between income levels and prevalence rates of arteriosclerotic heart diseases.[19] Such curvilinearity was not tested for in this analysis.

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[19] See discussion on levels of income and heart disease in Saad Z. Nagi and Wade H. Andrews, Field Studies in Heart Disease, Ohio Agricultural Experiment Station, Research Bulletin in Press.

It is also important to notice that these findings should not be used as a basis for comparing the prevalence of heart disease among farmers in the United States with those of other countries. Such a comparison must take into consideration cultural differences and a host of other complex variables.

High operational risks: Different types of farming involve different degrees of risks. Such risks may be connected with high capital investment as in the case of dairy and intensive farming. Production and market uncertainties present other sources of high risks, especially in the case of crops requiring intensive farming, such as fruits and vegetables. These crops are more susceptible to the uncontrolled conditions of weather, labor supply, and markets.

In view of the emotional strains and stresses such risks may create, a positive correlation would be expected to exist between arteriosclerotic heart disease rates and each of dairy and intensive types of farming. As indicated in Table 6, significant correlation values of ($r = .23$ $P < .05$) and ($r = .25$ $P < .05$) respectively, were obtained.

Inefficient farm operations: Inefficient operations and their results can be considered an important source of worry. Some inefficiencies are imposed by capital limitations or an imbalance in other means of production. The level of mechanization as measured and used in this analysis provides a case in illustration. Most small farmers maintain farm equipment that can be used more efficiently on larger size farms than the ones they operate. This fact is clearly demonstrated

in Table 6 by the high negative correlation found between the size of farms and the level of mechanization per acre in Ohio counties ($r = -.73$ $P < .001$).

The conclusion submitted here is that small farmers tend to use a larger proportion of their income and capital in farm equipment which is not used to optimum efficiency. This situation may be the result of a strong feeling of independence and self-sufficiency as well as the lack of more economically efficient units of equipment to suit the needs of their marginal and sub-marginal size farms. Regardless of the reasons behind this situation, it is expected to become a source of economic stress among low-income farmers. The negative correlation obtained between arteriosclerotic heart disease including coronary disease mortality and the level of mechanization per acre as shown in Table 6, provides evidence in support of this hypothesis ($r = 0.37$ $P < .01$).

The Role of Occupational Stresses

Although normal exercise is recommended for the heart condition, much physical strain can be hazardous to the heart as well as to the health in general. Such hazards are usually emphasized by occupational worries and poor working conditions.

Part-time farming is considered here as representing certain aspects of occupational stresses. Besides maintaining their farm operations, part-time farmers are expected to meet the obligations of one or more other jobs. The off-farm work in which they engage is usually

that of unskilled or semi-skilled labor, which requires more physical effort than most other non-farm occupations. Therefore, a positive association would be anticipated between rates of arteriosclerotic heart disease and part-time farming. Results obtained and presented in Table 6 substantiate this hypothesis, ($r = .26$ $P < .01$).

Elements of occupational stresses can be detected also in work schedules of dairy farmers as well as the type and amount of work required in intensive farming. As mentioned above and illustrated in Table 6, these two types of farming were found to be correlated positively with arteriosclerotic heart disease death rates.

It should be emphasized at this point that correlation coefficients in themselves do not establish causal explanations. The above suggested interpretations relating emotional and occupational stresses to arteriosclerotic including coronary diseases of the heart are advanced only as hypotheses for further investigation.

APPENDIX I

Mortality by Types of Heart Disease in Ohio Counties'
General Health Jurisdictions*
Crude Rates Per 100,000 Population

County	Types of Heart Disease					
	410-416**	420	421,422	440-443	423-434	410-443
Adams	28.70	325.22	86.09	43.04	9.57	192.61
Allen	2.66	255.03	77.04	26.57	5.31	366.60
Ashland	0	254.66	70.74	18.86	28.30	372.55
Ashtabula	3.76	276.49	47.02	37.62	22.57	387.46
Athens	13.72	284.67	48.02	44.59	24.01	414.99
Auglaize	14.90	238.45	69.55	44.71	9.94	377.55
Belmont	8.17	307.14	75.15	27.77	11.44	429.68
Brown	0	350.83	112.61	103.95	4.33	571.73
Butler	3.25	195.16	29.27	47.16	4.88	279.72
Carroll	10.35	331.04	77.59	20.69	15.52	455.18
Champaign	5.16	253.03	15.49	30.98	15.49	320.17
Clark	10.02	360.76	12.53	17.54	12.53	413.37
Clermont	4.71	218.11	31.38	34.52	10.98	299.71
Clinton	28.08	290.19	23.40	14.04	28.08	383.81
Columbiana	21.40	346.32	27.24	54.48	3.89	453.33
Coshocton	0	286.84	148.73	10.62	21.25	467.44
Crawford	14.70	220.47	44.09	19.60	9.80	308.66
Cuyahoga	17.08	192.18	20.50	31.60	7.69	269.06
Darke	8.82	270.52	55.87	70.57	2.94	408.72
Defiance	0	321.17	57.81	12.85	38.54	430.37
Delaware	0	279.25	53.70	42.96	16.11	392.03
Erie	6.67	260.31	30.43	64.23	10.14	371.87
Fairfield	16.51	250.90	42.92	62.72	9.90	382.95
Fayette	15.47	208.88	54.15	7.74	7.74	293.98
Franklin	15.53	191.59	21.58	46.60	12.08	287.38
Fulton	7.04	274.47	91.49	77.42	3.52	453.94
Gallia	16.00	288.00	21.33	21.33	0	346.67

*Data are of 1956 obtained from the records of the Division of Vital Statistics of the Ohio Department of Health.

**Figures refer to types of heart disease as explained in pages 4-5 of the text.

APPENDIX I (Continued)

Mortality by Types of Heart Disease in Ohio Counties' General Health Jurisdictions*
Crude Rates Per 100,000 Population

County	Types of Heart Disease					
	410-416**	420	421,422	440-443	423-434	410-443
Geauga	11.44	211.69	65.80	28.61	22.89	340.42
Greene	4.56	166.31	15.95	6.83	11.39	205.04
Guernsey	4.48	295.55	35.82	53.74	22.39	411.98
Hamilton	14.21	245.69	29.10	41.96	8.12	339.09
Hancock	16.25	195.03	5.42	70.43	27.09	314.21
Hardin	4.72	264.36	28.32	23.60	14.16	335.17
Harrison	25.75	319.26	36.05	25.75	30.90	437.69
Henry	5.90	230.22	94.45	35.42	35.42	401.42
Highland	20.48	258.01	77.81	49.14	4.10	409.53
Hocking	0	203.33	60.25	15.06	22.59	301.23
Holmes	20.76	238.71	51.89	20.76	5.19	337.31
Huron	7.11	345.04	85.37	28.46	17.79	483.76
Jackson	11.00	225.52	16.50	22.00	5.50	280.53
Jefferson	15.01	294.55	54.41	30.02	15.01	408.99
Knox	4.07	223.74	69.16	44.75	4.07	345.71
Lake	10.11	225.82	16.85	37.08	11.80	301.66
Lawrence	8.51	258.17	51.07	45.39	2.84	365.98
Licking	9.55	322.29	38.20	69.23	9.55	448.82
Logan	17.53	232.21	61.34	48.19	13.14	372.42
Lorain	4.71	197.67	23.53	37.65	7.06	270.62
Lucas	11.19	195.83	27.04	30.77	19.58	284.42
Madison	13.88	235.94	32.38	13.88	9.25	305.33
Mahoning	9.35	273.89	28.06	38.75	4.01	354.06
Marion	15.93	228.27	47.78	74.32	5.31	371.61
Medina	9.16	268.71	30.54	27.48	6.11	341.99
Meigs	4.39	298.38	83.37	43.88	35.10	465.12
Mercer	12.17	223.04	52.72	40.55	24.33	352.81
Miami	2.77	259.92	35.95	52.54	11.06	362.23
Monroe	14.08	267.53	84.48	91.52	49.28	506.90
Montgomery	11.30	234.35	27.88	21.10	12.06	306.69

*Data are of 1956 obtained from the records of the Division of Vital Statistics of the Ohio Department of Health.

**Figures refer to types of heart disease as explained in pages 4-5 of the text.

APPENDIX I (Continued)

Mortality by Types of Heart Disease in Ohio Counties' General Health Jurisdictions*
Crude Rates Per 100,000 Population

County	Types of Heart Disease					
	410-416**	420	421,422	440-443	423-434	410-443
Morgan	35.05	324.05	70.10	43.81	43.81	517.00
Morrow	5.24	293.24	31.43	52.36	31.42	413.68
Muskingum	22.19	357.91	22.17	50.68	22.17	475.10
Noble	18.06	424.30	27.08	72.22	27.08	568.75
Ottawa	14.21	252.20	60.39	24.87	10.66	362.32
Paulding	11.95	203.20	29.88	11.95	17.93	274.92
Perry	25.82	317.17	140.14	62.70	14.75	560.58
Pickaway	4.49	220.15	44.93	22.46	26.96	318.99
Pike	4.20	151.12	41.98	33.58	12.59	243.47
Portage	13.27	157.39	39.82	26.55	3.79	240.83
Preble	12.80	255.93	67.18	44.79	12.80	393.50
Putnam	11.04	224.58	58.91	80.99	7.36	382.89
Richland	11.19	178.99	42.51	35.80	17.90	286.39
Ross	2.88	138.21	54.71	28.79	5.76	230.36
Sandusky	2.93	278.30	35.15	35.15	2.93	354.46
Scioto	5.85	113.08	50.69	23.40	3.90	196.42
Seneca	25.22	281.64	50.44	33.63	4.20	395.14
Shelby	4.75	199.67	52.29	28.52	14.26	299.50
Stark	12.99	214.65	26.74	27.50	7.64	289.51
Summit	14.43	204.41	28.86	21.09	13.32	281.90
Trumbull	11.44	236.09	24.96	33.28	9.36	315.13
Tuscarawas	16.11	306.16	52.95	41.44	18.42	435.07
Union	27.76	291.50	60.15	60.15	9.25	448.82
Van Wert	6.49	214.10	19.46	32.44	12.98	285.47
Vinton	8.96	224.07	89.63	26.89	17.93	367.48
Warren	17.55	236.96	39.49	19.75	13.16	326.92
Washington	13.22	333.88	56.20	26.45	13.22	442.98
Wayne	6.70	221.44	46.91	35.74	20.10	330.59
Williams	9.09	331.46	54.56	81.84	18.19	500.14
Wood	11.16	269.81	26.05	35.35	16.75	359.12
Wyandot	23.48	277.10	70.45	65.75	4.70	441.48

*Data are of 1956 obtained from the records of the Division of Vital Statistics of the Ohio Department of Health.

**Figures refer to types of heart disease as explained in pages 4-5 of the text.

APPENDIX II

Mortality by Types of Heart Disease in Ohio Counties' General Health Jurisdictions*
Age-Adjusted Rates Per 100,000 Population

County	Types of Heart Disease					
	410-416**	420	421,422	440-443	423-434	410-443
Adams	23.54	230.23	60.03	35.45	6.27	355.51
Allen	2.70	240.69	70.73	24.83	4.86	343.81
Ashland	0	210.21	55.24	15.63	25.80	306.89
Ashtabula	3.89	225.32	35.50	29.56	18.88	313.14
Athens	9.23	212.98	33.24	31.86	18.94	306.25
Auglaize	13.74	196.91	54.34	36.53	8.77	310.30
Belmont	8.03	250.38	58.53	21.55	9.88	348.35
Brown	0	242.71	71.73	69.40	2.70	386.53
Butler	4.22	254.21	38.61	61.78	6.37	365.19
Carroll	10.50	270.51	61.02	18.27	11.66	371.95
Champaign	3.73	199.65	13.02	26.05	11.19	253.64
Clark	11.08	339.97	11.19	16.28	11.80	390.32
Clermont	4.56	192.33	25.64	29.32	9.22	261.07
Clinton	24.32	213.43	20.46	10.97	20.32	289.50
Columbiana	21.57	310.48	24.44	45.52	3.72	405.73
Coshocton	0	245.34	120.39	8.39	16.79	390.91
Crawford	13.48	186.22	34.11	15.16	7.58	256.56
Cuyahoga	16.47	196.82	22.18	33.43	7.69	276.59
Darke	6.57	229.24	44.89	53.84	2.19	336.74
Defiance	0	257.45	44.99	11.12	29.03	342.58
Delaware	0	214.18	38.51	30.81	11.55	295.06
Erie	6.76	229.27	26.36	53.95	8.40	324.73
Fairfield	15.38	205.10	31.48	49.58	7.27	308.80
Fayette	14.33	179.29	43.51	6.22	6.22	249.55
Franklin	17.12	216.51	24.42	52.60	13.44	324.09
Fulton	7.06	214.63	67.10	56.92	2.54	348.25
Gallia	16.85	252.01	16.07	16.07	0	301.01

*Data are of 1956 obtained from the records of the Division of Vital Statistics of the Ohio Department of Health.

**Figures refer to types of heart disease as explained in pages 4-5 of the text.

APPENDIX II (Continued)

Mortality by Types of Heart Disease in Ohio Counties' General Health Jurisdictions*
Age-Adjusted Rates Per 100,000 Population

County	Types of Heart Disease					
	410-416**	420	421,422	440-443	423-434	410-443
Geauga	11.94	193.60	59.11	26.00	21.20	311.85
Greene	6.75	231.36	21.24	8.91	13.94	284.43
Guernsey	5.55	172.84	18.38	29.21	13.12	239.11
Hamilton	14.86	283.84	34.05	49.62	9.40	391.77
Hancock	17.14	152.31	4.02	55.90	23.09	241.50
Hardin	5.10	213.34	20.67	18.88	10.34	268.32
Harrison	21.81	242.50	28.38	22.70	23.22	338.59
Henry	4.37	189.64	75.41	26.21	27.69	323.32
Highland	16.66	181.01	52.96	33.09	2.64	286.36
Hocking	0	190.88	49.49	12.37	20.59	273.34
Holmes	23.35	237.35	51.22	21.65	4.69	338.26
Huron	7.56	283.79	64.93	21.40	14.11	391.80
Jackson	10.72	200.76	13.36	19.63	6.27	250.75
Jefferson	15.94	316.03	58.13	32.28	16.23	438.61
Knox	2.93	188.19	50.96	33.86	2.93	278.86
Lake	11.18	249.69	18.65	41.54	13.16	334.23
Lawrence	9.91	282.05	54.67	48.27	3.50	398.39
Licking	8.58	253.97	29.91	52.61	7.91	352.97
Logan	12.76	165.49	42.57	31.26	11.31	263.39
Lorain	5.00	213.99	25.57	40.93	7.54	293.02
Lucas	12.61	243.91	35.93	38.28	23.18	353.92
Madison	13.60	217.91	28.80	11.88	7.92	280.10
Mahoning	9.62	284.58	29.50	40.48	4.17	368.42
Marion	16.59	197.67	37.75	58.73	4.20	314.93
Medina	8.40	232.63	25.80	22.87	5.47	295.17
Meigs	2.92	226.32	60.25	32.39	23.33	345.19
Mercer	11.24	210.07	45.38	36.13	21.48	324.29

*Data are of 1956 obtained from the records of the Division of Vital Statistics of the Ohio Department of Health.

**Figures refer to types of heart disease as explained in pages 4-5 of the text.

APPENDIX II (Continued)

Mortality by Types of Heart Disease in Ohio Counties' General Health Jurisdictions*
Age-Adjusted Rates Per 100,000 Population

County	Types of Heart Disease					
	410-416	420	421,422	440-443	423-434	410-443
Miami	2.92	240.14	33.23	47.60	10.80	334.69
Monroe	7.94	173.53	57.79	54.46	27.80	321.71
Montgomery	13.88	333.21	41.43	29.28	16.91	434.09
Morgan	31.80	226.57	44.97	28.57	28.57	360.49
Morrow	5.74	222.47	23.67	42.49	26.20	320.57
Muskingum	22.80	305.26	18.24	41.45	17.43	405.19
Noble	15.16	312.13	15.63	45.41	15.63	403.96
Ottawa	13.72	212.39	49.46	20.76	8.61	304.94
Paulding	10.81	168.75	21.65	8.66	12.99	222.86
Perry	21.03	252.47	104.87	45.89	11.32	435.57
Pickaway	4.09	210.26	41.58	21.26	25.23	302.41
Pike	4.77	145.86	34.72	29.07	10.42	224.84
Portage	14.16	166.19	40.65	27.06	3.87	251.93
Preble	11.49	211.21	49.67	35.73	10.37	318.47
Putnam	12.74	189.40	44.58	64.65	6.69	318.07
Richland	13.05	218.71	51.62	43.93	21.10	348.11
Ross	3.15	145.57	56.14	29.75	6.08	240.47
Sandusky	3.25	227.61	27.56	27.26	2.21	287.90
Scioto	6.37	127.13	56.61	26.26	4.34	220.70
Seneca	26.24	252.89	45.68	29.74	3.45	358.00
Shelby	5.57	180.55	45.16	25.08	13.04	269.39
Stark	13.55	226.49	28.26	29.10	8.01	305.41
Summit	15.96	239.35	36.55	25.27	14.72	331.86
Trumbull	12.49	265.34	28.08	37.54	10.56	354.01
Tuscarawas	17.13	274.19	46.56	36.32	16.54	390.74
Union	21.84	206.57	39.07	42.20	6.01	315.69
Van Wert	4.59	168.76	13.76	22.94	9.17	219.21

*Data are of 1956 obtained from the records of the Division of Vital Statistics of the Ohio Department of Health.

**Figures refer to types of heart disease as explained in pages 4-5 of the text.

APPENDIX II (Continued)

Mortality by Types of Heart Disease in Ohio Counties' General Health Jurisdictions* Age-Adjusted Rates Per 100,000 Population

County	Types of Heart Disease					
	410-416**	420	421,422	440-443	423-434	410-443
Vinton	11.26	203.63	67.40	23.95	15.87	322.11
Warren	17.13	229.30	36.91	17.66	12.15	313.15
Washington	12.23	258.19	38.61	19.91	8.82	337.74
Wayne	7.51	208.98	42.85	33.94	18.44	311.72
Williams	5.86	240.47	36.50	52.77	11.73	347.33
Wood	10.58	233.55	21.91	28.71	14.36	309.10
Wyandot	22.28	215.10	46.51	46.79	3.10	333.77

*Data are of 1956 obtained from the records of the Division of Vital Statistics of the Ohio Department of Health.

**Figures refer to types of heart disease as explained in pages 4-5 of the text.

APPENDIX III

Ranks of Ohio Counties on the Demographic, Occupational, Sociological and Economic Variables Used in the Analysis*

County	Variables**										
	1	2	3	4	5	6	7	8	9	10	11
Adams	4	32	11	34	66.5	19	47	83	67	14	1
Allen	82	27	5	62	72	28	51	15	76	67	71
Ashland	85.5	58	18	79	6	56	24	43	45	73	48
Ashtabula	75	43	52	46	18	50	38	28	21	64	64
Athens	51	54	56	41	17	57	21	40	55	19	57
Auglaize	28	67	20	30	54	53	30	45	14	49	30
Belmont	54	21	13	68	49	23	57	19	22	33	69
Brown	85.5	24	4	1	83	13	27	79	55	11	3
Butler	73	16	44.5	3	65	16	87	10	84	70	78
Carroll	48	12	9	75	39	14	33	73	58	42	32
Champaign	76	65	86	58	43	78	41	61	65	45	25
Clark	44	1	87	77	37	12	85	12	79	75	76
Clermont	71	70	68	47	51	76	41	39	69	1	42
Clinton	3	52	78	84	16	65	28	61	81	32	22
Columbiana	10	5	70	19	78	4	17	17	13	69	72
Coshocton	85.5	23	1	87	22	10	13	66	25	40	40
Crawford	32	75	54	80	61	77	63	35	8	86	54
Cuyahoga	19	68	73	37	60	71	81	1	58	88	88
Darke	61	38	35	9	87	33	35	50	17	34	17
Defiance	85.5	14	33	83	1	29	57	58	35	83	33
Delaware	85.5	50	46	43	40	63	67	55	61	59	29
Erie	59	37	66	8	56	38	79	16	81	60	73
Fairfield	22	62	58	14	63	55	75	33	57	50	51
Fayette	25	78	37	88	68	81	22	67	77	71	23
Franklin	15	47	71	12	31	40	67	5	86	84	83
Fulton	58	49	7	5	85	24	12	58	10	16	18
Gallia	16	20	82	78	88	61	77	70	52	74	10

*Sources of data are explained in pages 4 to 9 of the text.

**Variables are referred to by numbers at the head of each column, see pages 4 to 9 of the text.

APPENDIX III (Continued)

Ranks of Ohio Counties on the Demographic, Occupational, Sociological and Economic Variables Used in the Analysis*

	Variables**										
County	1	2	3	4	5	6	7	8	9	10	11
Geauga	39	69	12	59	13	51	17	53	74	2	38
Greene	60	34	76	85	25	68	50	21	88	15	62
Guernsey	66	80	80	49	33	84	34	46	7	35	41
Hamilton	24	8	55	13	50	9	87	2	61	87	86
Hancock	12	85	88	6	11	82	70	41	48	82	43
Hardin	67	53	77	74	48	74	45	64	45	61	19
Harrison	9	25	62	66	9	30	3	77	37	5	44
Henry	72	72	3	57	4	41	45	69	10	48	12
Highland	17	76	21	38	84	67	19	72	50	72	11
Hocking	85.5	71	26	81	15	72	27	78	29	36	55
Holmes	5	31	23	67	73	31	7	80	5	29	5
Huron	56	9	8	69	30	8	82	43	10	65	52
Jackson	46	64	85	73	66.5	80	40	55	16	57	49
Jefferson	21	3	14	40	24	1	58	14	47	20	79
Knox	79	74	24	36	82	70	83	53	47	38	39
Lake	43	22	79	24	32	35	54	9	65	30	75
Lawrence	49	10	19	15	79	7	47	30	71	21	61
Licking	52	17	59	11	59	22	61	33	32	63	58
Logan	34	84	39	42	42	75	71	51	19	28	35
Lorain	68	51	69	26	62	64	74	11	72	77	77
Lucas	36	26	51	28	10	21	86	3	39	80	85
Madison	30	46	61	82	58	69	29	75	78	18	14
Mahoning	50	7	60	27	76	15	84	7	29	79	82
Marion	18	66	47	4	75	48	49	25	31	81	66
Medina	53	33	67	65	71	62	65	37	60	31	46
Meigs	80.5	42	10	39	8	27	10	69	25	47	24
Mercer	42	59	31	32	12	39	2	61	18	26	20

*Sources of data are explained in pages 4 to 9 of the text.

**Variables are referred to by numbers at the head of each column, see pages 4 to 9 of the text.

APPENDIX III (Continued)

Ranks of Ohio Counties on the Demographic, Occupational, Sociological and Economic Variables Used in the Analysis*

County	Variables**										
	1	2	3	4	5	6	7	8	9	10	11
Miami	80.5	29	57	16	44	34	48	20	71	51	63
Monroe	55	79	15	7	3	43	25	84	2	22	2
Montgomery	27	2	41	48	21	3	80	6	83	55	84
Morgan	1	40	34	53	2	17	66	86	27	12	6
Morrow	64	44	72	22	5	44	15	81	15	10	9
Muskingum	6	6	81	25	20	5	72	28	42	54	67
Noble	23	4	83	20	27	6	15	87	2	17	4
Ottawa	29	55	27	71	55	59	39	28	74	3	60
Paulding	45	82	75	86	35	86	8	82	35	4	15
Perry	11	19	2	18	41	2	9	47	5	6	53
Pickaway	74	57	40	70	7	60	69	65	63	24	16
Pike	69	86	53	51	46	85	23	85	64	7	7
Portage	26	83	42	55	77	79	55	24	85	37	65
Preble	40	56	25	33	47	45	11	58	74	13	26
Putnam	35	73	36	2	64	46	5	71	5	23	8
Richland	33	45	22	21	14	25	65	18	54	52	74
Ross	78	87	17	44	69	83	60	43	79	27	50
Sandusky	77	39	65	54	86	66	54	26	27	62	59
Scioto	62	88	16	56	74	87	59	22	59	43	70
Seneca	2	18	30	45	80	18	54	35	38	78	56
Shelby	65	77	32	61	34	73	78	49	41	66	31
Stark	31	41	63	50	57	58	37	8	37	58	81
Summit	20	30	49	60	28	37	83	4	33	85	87
Trumbull	37	13	64	29	45	20	75	13	43	41	80
Tuscarawas	13.5	11	28	31	23	11	21	23	2	56	68
Union	8	61	43	23	70	47	19	75	23	39	13
Van Wert	70	81	84	64	52	88	4	55	19	76	36

*Sources of data are explained in pages 4 to 9 of the text.

**Variables are referred to by numbers at the head of each column, see pages 4 to 9 of the text.

APPENDIX III (Continued)

Ranks of Ohio Counties on the Demographic, Occupational, Sociological and Economic Variables Used in the Analysis*

	Variables**										
County	1	2	3	4	5	6	7	8	9	10	11
Vinton	41	63	6	63	26	42	6	88	49	8	27
Warren	13.5	36	48	76	36	49	73	38	87	9	45
Washington	38	14	44.5	72	53	32	32	49	40	44	34
Wayne	57	60	38	35	19	52	35	31	52	46	37
Williams	63	28	50	10	38	26	61	61	26	53	28
Wood	47	32	74	52	29	54	31	35	68	25	47
Wyandot	7	46	29	17	81	36	1	73	12	68	21

*Sources of data are explained in pages 4 to 9 of the text.

**Variables are referred to by numbers at the head of each column, see pages 4 to 9 of the text.

APPENDIX III (Continued)

Ranks of Ohio Counties on the Demographic, Occupational, Sociological and Economic Variables Used in the Analysis*

	Variables**											
County	12	13	14	15	16	17	18	19	20	21	22	23
Adams	84	87	84	81	39	75	68	35	34	41	86	83
Allen	11	20	19	45	28	28	46	37	69	56	70.5	68
Ashland	55	39	10	36	50	61	53	41	43	48	22	40
Ashtabula	62	35	16	17	88	64	63	74	72	12	1	12
Athens	77	75	50	42	70	78	84	79	42	18	51.5	27
Auglaize	25	28	44	71	23	37	19	18	45	76	39	87
Belmont	68	66	74	39	65	73	74	72	65	33	38	24
Brown	72	83	75	69	44	68	64	26	61	53	85	84
Butler	28	30	45	30	33	19	31	45	56	34	15	69
Carroll	70	50	57	34	83	72	70	56	31	36	44.5	38
Champaign	33	46	36	68	8	22	11	30	17	62	9	76
Clark	4	17	17	24	27	15	5	42	27	54	14	58
Clermont	56	64	58	22	57	54	72	69	77	17	57.5	28
Clinton	15	55	48	80	6	12	4	24	11	65	87	80
Columbiana	49	21	51	35	79	63	59	64	76	10	21	10
Coshocton	69	65	39	61	62	66	57	48	10	51	56	32
Crawford	12	10	23	57	29	36	23	23	19	77	50	53
Cuyahoga	19	1	13	19	87	8	9	81	88	1	12	1
Darke	45	51	59	62	16	39	34	20	73	52	70.5	65
Defiance	22	44	30	51	25	34	35	15	16	71	78	51
Delaware	29	36	4	67	47	43	42	40	41	57	23	71
Erie	14	11	24	63	42	29	38	45	60	24	17	8
Fairfield	26	47	34	18	38	46	45	43	58	40	48	48
Fayette	2	58	60	88	1	2	2	13	2	84	81	77
Franklin	5	12	3	32	40	26	30	51	68	39	7	36
Fulton	8	5	40	44	30	24	6	11	62	58	34	21
Gallia	63	45	9	9	67	41	56	71	67	27	2	17

*Sources of data are explained in pages 4 to 9 of the text.

**Variables are referred to by numbers at the head of each column, see pages 4 to 9 of the text.

APPENDIX III (Continued)

Ranks of Ohio Counties on the Demographic, Occupational, Sociological and Economic Variables Used in the Analysis*

	Variables**											
County	12	13	14	15	16	17	18	19	20	21	22	23
Geauga	63	45	9	9	67	41	56	71	67	27	2	17
Greene	9	33	1	55	7	11	7	30	29	59	30	63
Guernsey	85	70	69	46	74	76	85	59	32	32	73	50
Hamilton	51	14	46	64	52	18	49	77	85	4	6	5
Hancock	20	22	5	77	12	10	17	4	23	80	72	59
Hardin	30	56	49	83	13	16	12	5	9	86	76	55
Harrison	75	59	76	56	68	71	73	62	7	26	44.5	54
Henry	13	37	61	74	4	6	8	1	40	72	77	29
Highland	53	71	70	76	24	57	44	27	22	60	75	85
Hocking	76	78	77	12	55	83	82	82	15	31	83	43
Holmes	88	85	78	70	43	53	41	25	36	81	24	60
Huron	21	29	28	41	45	47	43	34	26	43	41	39
Jackson	81	79	80	11	85	86	86	80	46	37	42.5	13
Jefferson	74	53	71	26	81	67	75	84	55	6	33	20
Knox	42	40	11	48	46	60	47	38	25	61	36	70
Lake	37	2	2	8	84	44	32	83	86	2	20	2
Lawrence	82	82	81	2	64	84	69	86	79	5	32	3
Licking	53	48	18	53	48	51	51	47	47	45	28	49
Logan	16	52	8	49	26	40	37	31	18	73	31	74
Lorain	24	4	14	13	63	45	40	55	75	13	3	14
Lucas	34	15	29	14	49	17	29	57	84	15	51.5	4
Madison	10	67	62	82	2	1	1	7	1	87	26	67
Mahoning	36	6	41	10	78	59	58	67	81	14	16	9
Marion	35	18	20	73	21	13	10	19	6	79	42.5	78
Medina	23	7	7	33	69	50	50	50	74	20	4	31
Meigs	79	72	82	20	75	81	83	75	51	7	61	18
Mercer	61	54	63	78	32	21	18	6	44	82	53	72

*Sources of data are explained in pages 4 to 9 of the text.

**Variables are referred to by numbers at the head of each column, see pages 4 to 9 of the text.

APPENDIX III (Continued)

Ranks of Ohio Counties on the Demographic, Occupational, Sociological and Economic Variables Used in the Analysis*

	Variables**											
County	12	13	14	15	16	17	18	19	20	21	22	23
Miami	17	23	21	38	9	27	20	33	66	42	47	62
Monroe	66	88	86	15	71	88	87	65	50	49	74	45
Montgomery	31	13	15	25	41	30	48	54	83	19	37	37
Morgan	71	80	64	21	56	80	77	53	20	46	79	47
Morrow	50	60	31	31	51	58	55	39	48	66	49	82
Muskingum	57	68	52	7	61	70	65	60	30	25	55	34
Noble	80	77	79	16	58	85	79	49	28	64	84	75
Ottawa	67	24	37	58	37	31	52	32	70	29	64	7
Paulding	46	61	53	79	14	7	26	8	4	88	87	57
Perry	65	69	65	47	53	74	71	70	53	35	68	66
Pickaway	1	62	72	86	3	3	3	17	3	74	63	41
Pike	86	86	88	23	59	69	76	76	12	44	69	73
Portage	47	8	6	3	82	55	62	73	78	8	11	15
Preble	39	41	35	43	20	33	22	29	49	50	54	86
Putnam	3	38	66	85	15	14	15	3	39	83	80	46
Richland	48	25	25	37	54	52	60	52	59	30	46	44
Ross	58	73	73	50	34	48	39	58	5	63	65	42
Sandusky	6	19	26	54	17	25	21	21	38	55	36	23
Scioto	83	76	87	28	76	79	78	85	71	16	19	19
Seneca	18	26	32	66	5	32	27	9	14	68	57.5	61
Shelby	40	49	54	65	22	20	28	16	37	67	40	88
Stark	44	9	38	29	73	56	54	66	82	11	13	16
Summit	27	3	12	1	80	49	66	88	8	3	10	6
Trumbull	59	16	27	6	86	62	67	78	80	89	8	22
Tuscarawas	64	63	67	4	60	65	61	61	54	28	18	26
Union	32	57	42	72	31	23	24	22	21	75	29	79
Van Wert	43	42	47	84	11	4	16	2	13	85	82	64

*Sources of data are explained in pages 4 to 9 of the text.

**Variables are referred to by numbers at the head of each column, see pages 4 to 9 of the text.

APPENDIX III (Continued)

Ranks of Ohio Counties on the Demographic, Occupational, Sociological and Economic Variables Used in the Analysis*

	Variables**											
County	12	13	14	15	16	17	18	19	20	21	22	23
Vinton	87	84	83	5	77	87	88	87	24	22	88	25
Warren	41	43	55	40	36	38	36	44	52	38	25	56
Washington	73	73	68	625	72	77	80	68	57	23	60	11
Wayne	60	34	33	52	35	42	25	28	64	47	5	33
Williams	54	31	43	59	18	35	33	10	33	69	59	52
Wood	7	32	22	75	10	5	13	12	35	70	66	35
Wyandot	38	27	56	87	19	9	14	14	8	78	62	81

*Sources of data are explained in pages 4 to 9 of the text.

**Variables are referred to by numbers at the head of each column, see pages 4 to 9 of the text.